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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte BALACHANDAR VARATHARAJAN, CHELLAPPA BALAN,
and DEBASHIS DEY

Appeal 2009-002801
Application 10/681,704
Technology Center 1700

Decided:[1] May 26, 2009

Before ROMULO H. DELMENDO, MARK NAGUMO, and
KAREN M. HASTINGS, *Administrative Patent Judges*.

DELMENDO, *Administrative Patent Judge*.

DECISION ON APPEAL

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[1] The two-month time period for filing an appeal or commencing a civil action, as recited in 37 C.F.R. § 1.304, begins to run from the decided date shown on this page of the decision. The time period does not run from the Mail Date (paper delivery) or Notification Date (electronic delivery).

Appellants appeal under 35 U.S.C. § 134(a) from a final rejection of claims 1-8, 12-14, 17, 18, 20, and 27. (Appeal Brief filed July 27, 2007, hereinafter "Br."; Final Office Action mailed December 18, 2006). Claims 15, 16, 19, and 21-26, the only other pending claims, have been withdrawn from consideration. We have jurisdiction under 35 U.S.C. § 6(b).

We REVERSE.

STATEMENT OF THE CASE

Appellants state that the claimed invention relates to "hybrid power plants with integrated fuel cells, where the controlled injection of exhaust air from the fuel cell is used to burn the spent fuel from the fuel cells" (Specification, hereinafter "Spec.," ¶ 0001). According to Appellants, in one aspect of the invention, "[a] control system is used for controlling the amount of [a] cathode exhaust stream introduced in [a] tail gas burner for stable combustion and reduction of fuel and carbon monoxide emissions" (Spec. ¶ 0005).

Claims 1 and 27, the only independent claims on appeal, read as follows:

> 1. A hybrid power generation system for generating electrical power comprising:
>
> a compressor for producing a compressed oxidant;
>
> a recuperator in flow communication with said compressor;
>
> a fuel cell assembly comprising a plurality of fuel cells in flow communication with said recuperator to provide the compressed oxidant for said fuel cell assembly, said fuel cell assembly further comprising a cathode inlet for receiving the compressed oxidant, an anode inlet for receiving a fuel stream, an anode outlet in flow communication with an anode exhaust

stream and a cathode outlet in flow communication with a cathode exhaust stream; wherein at least a portion of the fuel stream reacts with the oxidant to produce electrical power;

a tail gas burner in fluid communication with the anode outlet and the cathode outlet; said tail gas burner configured for combusting a mixture of at least a portion of the anode exhaust stream and at least a portion of the cathode exhaust stream and producing a hot compressed gas, wherein the tail gas burner comprises a primary zone and a secondary zone;

a control system for controlling the amount of the cathode exhaust stream introduced in the tail gas burner for stable combustion and reduction of fuel and carbon monoxide emission, wherein less than 20 percent of the cathode exhaust stream by mass is diverted to the primary zone of the tail gas burner and about 5 percent to about 100 percent of the cathode exhaust stream by mass is diverted to the secondary zone of the tail gas burner; and

a turbine expanding said hot compressed gas and producing electrical power and an expanded gas.

27. A hybrid power generation system for generating electrical power comprising:

a compressor for producing compressed air;

a recuperator in flow communication with said compressor;

a solid oxide fuel cell assembly comprising a plurality of solid oxide fuel cells in flow communication with said recuperator to provide the compressed air for said solid oxide fuel cell assembly, said fuel cell assembly further comprising a cathode inlet for receiving the compressed air, an anode inlet for receiving a fuel stream, an anode outlet in flow communication with an anode exhaust stream and a cathode outlet in flow communication with a cathode exhaust stream; wherein at least a portion of the fuel stream reacts with the air to produce electrical power;

a tail gas burner in fluid communication with the anode outlet and the cathode outlet; said tail gas burner configured for

> combusting a mixture of at least a portion of the anode exhaust stream and at least a portion of the cathode exhaust stream and producing a hot compressed gas, wherein the tail gas burner comprises a primary zone and a secondary zone;
>
> a control system for controlling the amount of the cathode exhaust stream introduced in the tail gas burner for stable combustion and reduction of fuel and carbon monoxide emission, wherein less than 20 percent of the cathode exhaust stream by mass is diverted to the primary zone of the tail gas burner and about 5 percent to about 100 percent of the cathode exhaust stream by mass is diverted to the secondary zone of the tail gas burner; and
>
> a turbine for expanding said hot compressed gas and producing electrical power and an expanded gas.

(Br. 15; Appendix of Claims on Appeal.)

The Examiner relied upon the following as evidence of unpatentabiity:

Domeracki	5,413,879	May 9, 1995
Rosen	6,213,234 B1	Apr. 10, 2001

The Examiner rejected the claims as follows:

(i) claims 1-8, 12-14, 17, 18, 20, and 27 under 35 U.S.C. § 102(b) as anticipated by Domeracki (Examiner's Answer, hereinafter "Ans.," 3);

(ii) claims 1-8, 12-14, 17, 18, 20, and 27 under 35 U.S.C. § 103(a) as unpatentable in view of Domeracki (Ans. 9); and

(iii) claims 1-8, 12-14, 17, 18, 20, and 27 under 35 U.S.C. § 103(a) as unpatentable in view of the combined teachings of Domeracki and Rosen (Ans. 17).

ISSUES

Rejection (i):

The Examiner asserted “nowhere in the claims [is it] required that the cathode exhaust stream be separated/split into first and second different streams (two different streams) and thereafter direct[] the first stream towards the primary zone and the second stream towards the secondary zone” (Ans. 6). Also, the Examiner contended that “applicant’s control system cannot be accorded unclaimed physical or functional attributes other than what is just recited in the present claims which is simply to allow (and not necessarily controlling) cathode exhaust stream to be fed into the tail gas burner” (*id.* at 29). According to the Examiner, Appellants disclose as part of their invention a “passive control scheme,” which is “sufficient to establish that no additional component or feature such as a controlling unit, controlling valve, flow meters or devices responsive to sensed measurement are *necessary* to operate the claimed hybrid power generation system in order to achieve the apparent degree of control” (*id.*). After construing the recited “control system” in this fashion, the Examiner asserted that “Domeracki . . . implicitly discloses controlling the amount of both un-reacted fuel and oxidant to promote combustion” (*id.* at 4).

Appellants, on the other hand, contended that Domeracki “does not describe a control system for controlling anode and cathode exhaust from the fuel cell” (Br. 10). In particular, Appellants asserted that “Domeracki neither suggests nor discloses any split of fuel or air into primary and secondary zones of the tail gas burner as described in the claims 1 and 27 of the present application” (*id.*).

Thus, the issue arising from the contentions of the Examiner and Appellants is:

Have Appellants shown reversible error in the Examiner's claim interpretation that the "control system" recited in claims 1 and 27[2] does not require the presence of additional control components that provide a capability to split and divert the cathode exhaust stream into two distinct zones of the tail gas burner in the recited flow diversion ratios?

Rejection (ii):

With respect to the obviousness rejection based on Domeracki alone, Appellants maintain their argument Domeracki does not disclose the recited "control system." (Br. 12). Thus, the issue raised by this rejection is the same as in Rejection (i).

Rejection (iii):

With regard to the obviousness rejection based on Domeracki and Rosen, the Examiner contended that the claimed subject matter is unpatentable even "assuming . . . that Domeracki et al fails to expressly disclose the specific percent of the cathode exhaust stream and the specific control system" (Ans. at 24-25). Specifically, the Examiner asserted that Rosen discloses "a controller wherein all the air valves and the fuel valves are controlled . . . in order to precisely meter fuel and air in order to achieve the proper air/fuel balance, appropriate power output and turbine exhaust gas emissions" (*id.* at 24). The Examiner then concluded that it would have been obvious to one of ordinary skill in the art to modify Domeracki's fuel cell/turbine system by using Rosen's control system to precisely meter fuel and air (*id.* at 25).

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[2] As shown above, these claims recite: "control system for controlling the amount of the cathode exhaust stream introduced in the tail gas burner for stable combustion and reduction of fuel and carbon monoxide emission, wherein less than 20 percent of the cathode exhaust stream by mass is diverted to the primary zone of the tail gas burner and about 5 percent to about 100 percent of the cathode exhaust stream by mass is diverted to the secondary zone of the tail gas burner."

Appellants, on the other hand, contended that "the function of [Rosen's] power controller does not include regulating cathode exhaust to a combustor to control flame stability and reduce carbon monoxide" (Br. at 13-14).

Thus, the issue arising from the contentions of the Examiner and Appellants is:

Have Appellants shown reversible error in the Examiner's conclusion that Rosen would have prompted a person having ordinary skill in the art to modify Domeracki by providing a "control system for controlling the amount of the cathode exhaust stream . . . " as recited in claims 1 and 27?

FINDINGS OF FACT

1. Appellants' Specification discloses that a portion of spent air from the fuel cell assembly and a portion of spent fuel (i.e., anode exhaust stream) is fed to a tail gas burner (TGB), wherein the mixture is combusted (Spec. ¶ 0020).
2. The Specification discloses that the TGB is designed to handle fuel with a very low heat content, in which the TGB is divided into two zones – a primary zone and a secondary zone (Spec. ¶ 0023).

3. The Specification discloses that the oxygen content in the spent oxygen stream may be less than or equal to 25% by volume and "[i]t is very important to control the injection of the amount of this oxygen depleted spent air . . . into the TGB . . . for burning the low heat content anode exhaust stream" (Spec. ¶ 0022).
4. The Specification discloses that "air injection may be controlled by a passive or an active control or a combination of both" (Spec. ¶ 0025).
5. Fig. 5 of the Specification is reproduced below:

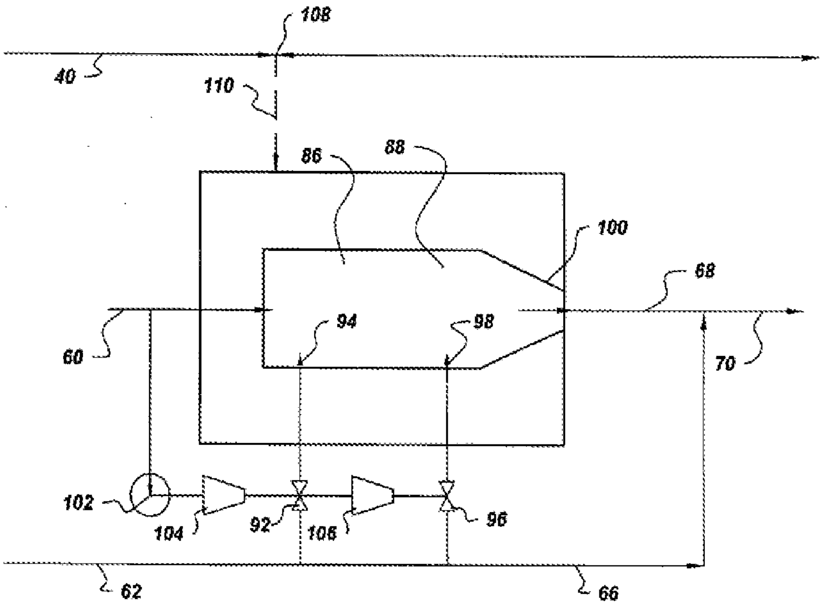

Fig. 5

Fig. 5 depicts an exemplary scheme for a passive control scheme for spent air injection into the primary zone 86 and the secondary zone 88 of a TGB (Spec. ¶ 0025).

6. The Specification discloses a passive control scheme as follows:

> In [a passive] control scheme, the spent air injection to the primary zone 86 is done through a primary control algorithm G(U) and the spent air injection to the secondary zone 88 is achieved through a secondary

> control algorithm H(V), wherein both (U) and (V) are functions of several process parameters related to the operation and performance of the fuel cell assembly 34. These algorithms, G(U) and H(V), determine the mass of air to be injected into each of the zones to achieve flame stability and reduced emissions. . . .
>
> The input parameters for the control algorithms are provided by a set of sensors 102. . . . The parameters are fed into the actuators 104 for primary zone 86 and 106 for secondary zone 88. Accordingly[,] the opening of the control valves 92 and 96 determines the mass of air to be injected into the primary and secondary zones . . . The mass of air injected into the primary zone 86 may be less than about 20% of the total cathode exhaust stream 54. Accordingly, the mass of air injected into the secondary zone may vary from about 5% to about 100% of the cathode exhaust stream 54 [Spec. ¶¶ 0025 and 0026].

7. The Specification discloses an active control system as follows:

> The control of the spent air injection into the TGB 38 can also be achieved by active control scheme (not shown), wherein the input parameters are measured downstream of the TGB 38 and a feedback loop is provided, which feedback loop controls the opening and closing of the valves 92 and 96 [Spec. ¶ 0027].

8. Fig. 1 of Domeracki is reproduced below:

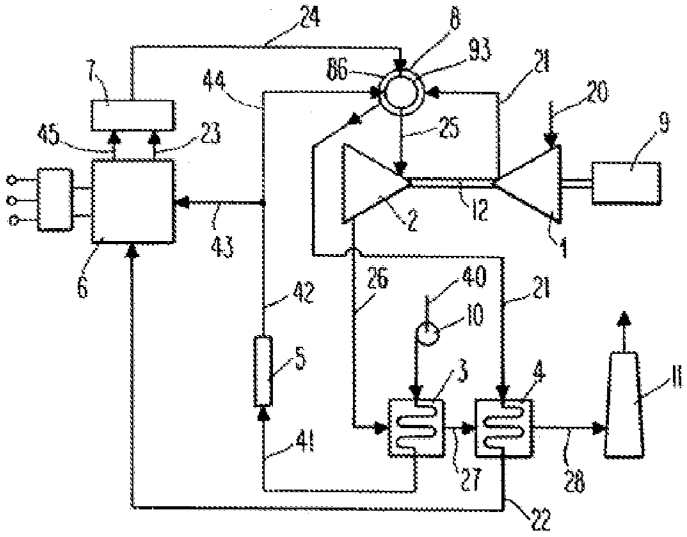

Fig.1

Fig. 1 depicts a schematic of a solid oxide fuel cell system including solid oxide fuel cell generator 6, combustion chamber 7, and topping combustor 8, wherein oxygen bearing gas (*i.e.*, essentially vitiated air) 23 (cathode exhaust stream) and spent fuel 45 from the fuel cell generator 6 are fed to the combustion chamber 7 (col. 2, ll. 41-49; col. 4, ll. 14-16).

9. Fig. 3 of Domeracki is reproduced below:

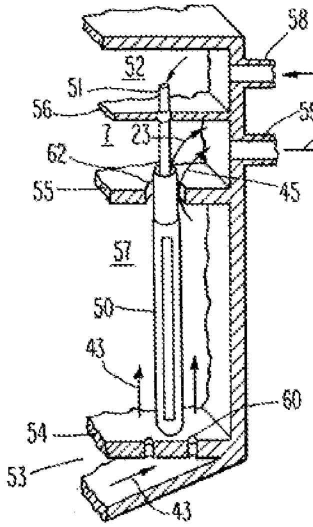

Fig. 3

Fig. 3 depicts combustion chamber 7, wherein hot gas 23 discharged from the fuel cells 50 mixes with spent fuel 45 from the reaction chamber 57 (col. 4, ll. 9-10 and 26-28).

10. Fig. 4 of Domeracki is reproduced below:

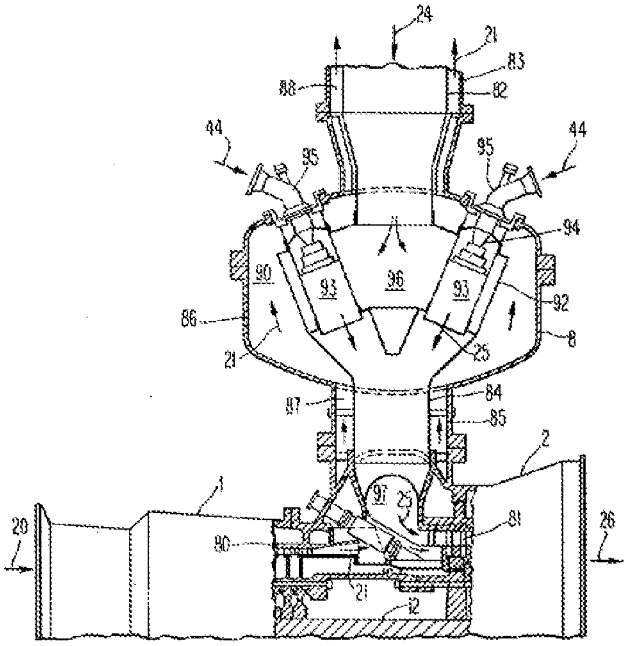

Fig. 4

Fig. 4 depicts the topping combustor including combustor baskets 93 positioned in combustor chamber 90 to accept hot gases 24 from combustion chamber 7 with supplemental fuel 44 for combustion to produce further heated gas 25 (col. 4, ll. 38-41 and 45-50; col. 5, ll. 1-10).

11. Fig. 2 of Rosen is reproduced below:

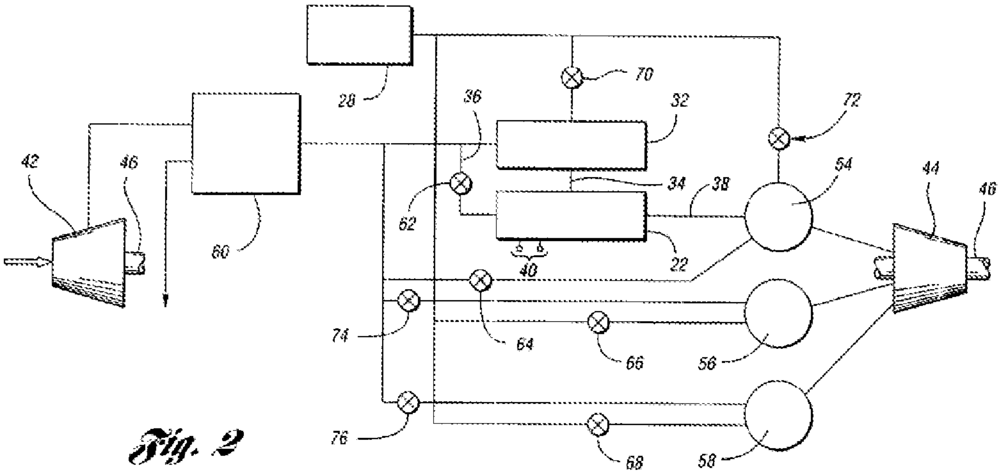

Fig. 2

Fig. 2 depicts a combination gas turbine engine including a compressor turbine 42 and a drive turbine 44 mounted on a common shaft, fuel cell 22, and combustors 54, 56, and 58 (4, ll. 33-35 and 39-42).

12. Rosen discloses that fuel cell exhaust gases 38 are fed to a combustor 54 (col. 4, ll. 42-44; Fig. 2).

13. Rosen discloses air control valves (64, 66, and 68) and fuel control valves (72, 74, and 76) for controlling air and fuel to combustors (54, 56, and 58) (col. 4, ll. 56-61; Fig. 2).

14. Rosen discloses controlling all air and fuel streams to the combustors except for the stream of exhaust gases from the fuel cell exhaust outlet 38 to the combustor 54 (Fig. 2).

PRINCIPLES OF LAW

The interpretation of a claim must be "reasonable in light of the totality of the written description." *In re Baker Hughes Inc.*, 215 F.3d 1297, 1303 (Fed. Cir. 2000).

"To anticipate a claim, a prior art reference must disclose every limitation of the claimed invention, either explicitly or inherently." *In re Schreiber*, 128 F.3d 1473, 1477 (Fed. Cir. 1997).

"Section 103 forbids issuance of a patent when 'the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.'" *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 406 (2007).

ANALYSIS

Rejection of Claims 1-8, 12-14, 17, 18, 20, and 27 as Anticipated by Domeracki

The Examiner construed the recited "control system . . . ." as not requiring any control structural elements that provide the capability to split the cathode exhaust stream into two streams to two zones of the TGB in the recited diversion ratios (Ans. 6).

This claim construction is erroneous. Claims 1 and 27, the only independent claims on appeal, require the TGB to have two zones – a primary zone and a secondary zone. These claims further require a control system with specific capabilities of splitting and diverting specified portions of the cathode exhaust stream to these primary and secondary zones of the TGB. In concluding that the claimed "control system" reads on a system without any control structural elements capable of splitting the cathode exhaust stream to primary and secondary zones of a TGB in the recited diversion ratios, the Examiner has either ignored explicit claim limitations as well as the enlightenment found in the Specification, or relied on an unsupported theory of inherency.

The ordinary engineering meaning, of a "system" that controls amounts of a fluid stream that are diverted to various parts of a combustion device includes structures that, at least within certain operating conditions, limit or otherwise "control" the diversion of the stream. Consistently, the Specification describes a control system for diverting and splitting spent air from a fuel cell to primary and secondary zones of a tail gas burner for combustion with spent fuel from the fuel cell (Facts 1-3). Specifically, the Specification describes the control system as passive, active, or a combination of both (Fact 4). With regard to the passive control system, the Specification describes a system comprising, *inter alia*, sensors, control valve actuators, and control valves for splitting and controlling the mass of air injected into the primary and secondary zones of a TGB (Facts 5 and 6). Similarly, the Specification describes the active control system as including control valves and a feedback loop for controlling opening and closing of the valves that split and divert the cathode exhaust stream to the primary and secondary zones of the TGB (Fact 7).

While limitations found in the Specification are not to be imported into a claim, these descriptions reasonably inform one of ordinary skill in the art that the control system recited in the independent claims requires some control structural elements that provide the capability for diverting and splitting the cathode exhaust stream to primary and secondary zones of a TGB in the recited diversion ratios. Thus, one of ordinary skill in the art would have understood that the control system recited in claims 1 and 27 could not reasonably be construed to cover mere piping that conveys all of the cathode exhaust stream to a TGB. *Baker Hughes Inc.*, 215 F.3d at 1303.

In contrast to the claimed subject matter, Domeracki discloses a system in which all of what can be regarded as the cathode exhaust stream flows into a combustion chamber 7 or topping combustor 8 (Facts 8-10). Domeracki does not teach any system that is capable of splitting and diverting the cathode exhaust stream in the recited diversion ratios to two separate zones of the combustion chamber 7 or topping combustor 8. To the extent that the Examiner relies on the combustor baskets 93 of the topping combustor 8 as the primary and secondary zones, the Examiner did not provide any evidence that Domeracki describes (or suggests) diversion of the cathode exhaust stream to each basket within the claimed ranges (i.e., "less than 20 percent of the cathode exhaust stream by mass is diverted to the primary zone of the tail gas burner and about 5 percent to about 100 percent of the cathode exhaust stream by mass is diverted to the secondary zone of the tail gas burner") (Fact 10; Ans. 3-36).

The Examiner further asserted that Domeracki discloses an auto-regulated control system wherein "the electrochemical reaction mechanism . . . auto-controls or auto-regulates the amount of cathode exhaust stream introduced in both combustion chamber 7 and topping combustor 8" (Ans. 30). However, this inherent "auto-control" characterization does not make up for the lack of any structure that could reasonably be considered a "control system" as that term, properly interpreted, is used in the appealed claims, i.e., structure with the capability to split and divert an exhaust stream to primary and secondary zones. Thus, the Examiner erred in interpreting the claims in a manner contrary to Appellants' Specification. For these reasons, we find that Domeracki does not disclose the control system with its capability of diverting the cathode exhaust stream to primary and secondary zones of a tail gas burner, as recited in claims 1 and 27.

Rejection of Claims 1-8, 12-14, 17, 18, 20, and 27 as Obvious in View of Domeracki

Because the issue for this rejection is the same as that for the anticipation rejection, we reverse for the same reasons given above.

Rejection of Claims 1-8, 12-14, 17, 18, 20, and 27 as Obvious in View of Domeracki and Rosen

The Examiner asserts that, assuming Domeracki fails to expressly disclose the specific control system, Rosen teaches a controller in which all air valves and fuel valves are controlled to precisely meter air and fuel to achieve a proper air/fuel balance (Ans. 24).

Appellants argue that Rosen's teaching of a power controller "does not include regulating cathode exhaust to a combustor to control flame stability and reduce carbon monoxide" (Br. 13-14).

Appellants' argument is persuasive. Rosen discloses a control system that controls air and fuel feeds to several combustors (Facts 11 and 13). However, Rosen discloses no valves or other control system components to control *fuel cell exhaust gases* to a combustor (Facts 11 and 12). Indeed, Rosen discloses controlling all air and fuel streams to the several combustors, *except* for the fuel cell exhaust stream (Fact 14). In light of these facts, we find that the Examiner has failed to provide sufficient evidence or reasoning to show that a person having ordinary skill in the art would have been prompted to combine Rosen with Domeracki in the manner claimed. Because the combined teachings of Rosen and Domeracki do not disclose all limitations of the claims (*i.e.*, the claimed control system with its capabilities), the Examiner has not established a prima facie case of obviousness.

CONCLUSION

Appellants have shown reversible error in the Examiner's claim interpretation that the "control system" recited in claims 1 and 27 does not require the presence of additional control components that provide a capability to split and divert the cathode exhaust stream into two distinct zones of the tail gas burner in the recited flow diversion ratios.

Appellants have also shown that the Examiner reversibly erred in concluding that Rosen would have prompted a person having ordinary skill in the art to modify Domeracki to arrive at the claimed subject matter.

DECISION

We reverse the Examiner's decision to reject:

(i) claims 1-8, 12-14, 17, 18, 20, and 27 under 35 U.S.C. § 102(b) as anticipated by Domeracki;

(ii) claims 1-8, 12-14, 17, 18, 20, and 27 under 35 U.S.C. § 103(a) as unpatentable in view of Domeracki; and

(iii) claims 1-8, 12-14, 17, 18, 20, and 27 under 35 U.S.C. § 103(a) as unpatentable in view of the combined teachings of Domeracki and Rosen.

REVERSED

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